UCRL- 93436
PREPRINT

THE Be-W (BERYLLIUM-TUNGSTEN) SYSTEM

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This paper was prepared for submittal to
Bulletin of Alloy Phase Diagrams

November 15, 1985

Lawrence Livermore National Laboratory

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February 28, 1986

TO: All holders of UCRL-93436 "The Be-W (Beryllium-Tungsten) System"
FROM: Technical Information Department

ERRATUM

Page 1

The fourth line from the bottom of the page should read as follows:

". . . forms from the melt by the peritectic reaction . . ."

Cynthia Talaber
Technical Information Department

The Be-W (Beryllium-Tungsten) System

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Equilibrium Diagram

The assessed Be-W phase diagram (Fig. 1) includes three intermediate phases, $Be_{22}W$, $Be_{12}W$, and Be_2W. The crystal structures of these phases have been well established (Table 1). However, the temperature and composition ranges of these phases were reported rather qualitatively in the form of a partial phase diagram by [63Gol] (also in [66Gol], and accepted by [Shunk]). The present phase diagram has been constructed with the same information, supplemented by the observations of [59Pai].

Homogeneity ranges of these phases were schematically described by [62Arz] based on examinations of diffusion couples. $Be_{12}W$ appears to have the narrowest range, but no quantitative values were reported.

(βBe) and (αBe) Terminal Solid Solutions. The melting point of (βBe) and the (βBe) --> (αBe) allotropic transformation temperature are 1289±4 and 1270±6 $^{\circ}$C, respectively [85BAP]. Phase relationships between L, (βBe) and (αBe) are not known. Metallographic examinations by [50Kau] indicated that the solubility limit of W in Be is less than 0.05 at.%.

$Be_{22}W$ (4.3 at.% W). [57Gla(58Che)] and [60Pai] pointed out the existence of a Be-rich fcc phase, and it was identified as $Be_{22}W$ by [61Boo], [62Mat] and [63Kri]. Considering the liquidus trend at the $Be_{12}W$ composition (see below) it is suggested that $Be_{22}W$ forms from the melt by the ~~eutectic~~ peritectic reaction L + $Be_{12}W$ --> $Be_{22}W$ (Fig. 1).

The superconducting transition temperature of $Be_{22}W$ is 4.12 K [67Buc].

[62Arz] identified a phase $Be_{24}W$ in a diffusion couple study at 900 to 1200 $^{\circ}$C with an increasing homogeneity range with increasing temperature. [66Sam] identified this phase as $Be_{22}W$ and this was confirmed by a subsequent diffusion couple experiment by [74Vas].

$Be_{12}W$ (7.7 at.% W). Existence of a phase in the vicinity of this composition was already recognized by [36Mis] and tentatively identified as $Be_{13}W$. The accepted stoichiometry, $Be_{12}W$, was established by [57Bat] and [57Gla(58Che)]. According to [59Pai], an alloy of this composition shows 'incipient' melting at 1750 and 1790 $^{\circ}$C. This is likely to correspond to a two-phase field above a peritectic temperature. Liquidus and peritectic reaction in Fig. 1 have been speculated according to this observation.

Be_2W. This phase was identified by [36Mis]. The melting point is lower than 2250 $^{\circ}$C [63Gol(66Gol)]. Variation of lattice parameters in alloys, heat treated at 1650 to 2100 $^{\circ}$C, suggests the existence of an asymmetric homogeneity range displaced toward W-rich side at high temperatures [63Gol(66Gol)]. Quantitative information for the phase boundaries were not given.

(W) Terminal Solid Solution and L --> Be_2W + (W) Eutectic Reaction. The melting point of W is 3422 $^{\circ}$C [Melt]. The solubility of Be in (W) is about 3 at.% at 1000 to 1300 $^{\circ}$C, and about 5 at.% at the L --> Be_2W +(W) eutectic temperature (estimated to be 2100 + 50 $^{\circ}$C) [63Gol(66Gol)]. The eutectic composition is reported as ~60 at.% W [63Gol(66Gol)].

Other Phase. An alloy with a low melting point forms when Be is deposited on a W filament at 1230 $^{\circ}$C [49Hac]. Composition and structure are unknown.

[80Tan] predicted the existence of a stable or metastable phase, BeW, having either CsCl or CrB-type crystal structure from the study of a series of equiatomic alloys based on Be.

Crystal Structures

A summary of crystal structure and lattice parameter data is given in Table 1.

Thermodynamics.

No thermodynamic data are available. The experimental phase diagram is not accurate enough for thermodynamic modeling. [74Zag] estimated the heat of mixing of liquid Be-W as -4640X(1-X) J/mol from atomic volumes of elements. Experimental justification is needed.

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* Indicates key paper.
# Indicates presence of a phase diagram.

Acknowledgements

Be-W evaluation contributed by L.E. Tanner, L-217, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, CA 94550 and H. Okamoto, B77G, Lawrence Berkeley National Laboratory, Berkeley, CA 94720. Work was supported by the U.S. Department of Energy under contract no. W-7405-Eng-48 and American Society for Metals (ASM). Literature searched through 1984. Part of the bibliographic search was provided by ASM. L.E. Tanner and H. Okamoto are ASM/NBS Data Program Category Editors for binary beryllium alloys.

Table 1 Be-W Crystal Structure and Lattice Parameter Data

Phase	Composition range, at.% W (a)	Pearson symbol	Strukturbericht designation	Space group	Prototype	Lattice parameters, nm a	c	Reference
(βBe)....	0	cI2	A2	Im3m	W	0.25515	...	[King2](b)
(αBe)....	0	hP2	A3	$P6_3/mmc$	Mg	0.22857	0.35839	[King1](b)
$Be_{24}W$?...	4	tetragonal		...	(c)	0.7865	1.2755	[62Arz]
$Be_{22}W$....	4.3	cF184	...	Fd3m	$Zn_{22}Zr$	1.1628	...	[62Mat]
						1.1631	...	[63Kri]
					(d)	1.161	...	[57Gla]
					(d)	1.164	...	[60Pai]
$Be_{12}W$....	7.7	tI26	$D2_b$	I4/mmm	$Mn_{12}Th$	0.7362	0.4216	[57Bat]
						0.7234	0.4232	[57Gla]
						0.730	0.429	[62Arz]
	?	tetragonal		...	(d)	1.014	0.423	[36Mis]
Be_2W...	~28 to ~36	hP12	C14	$P6_3/mmc$	$MgZn_2$	0.4446	0.7289	[36Mis]
	(e)					0.4578	0.7429	[63Gol](f)
	(g)					0.4559	0.7333	
(W)....	~95 to 100	cI2	A2	Im3m	W	0.31651	...	[King1](b)
	(e)					0.31623	...	[63Gol](f)

(a) from phase diagram. (b) assessed value for pure elements. (c) not accepted in equilibrium phase diagram. (d) compound not identified. (e) Be-rich end. (f) also in [66Gol]. (g) W-rich end.

F

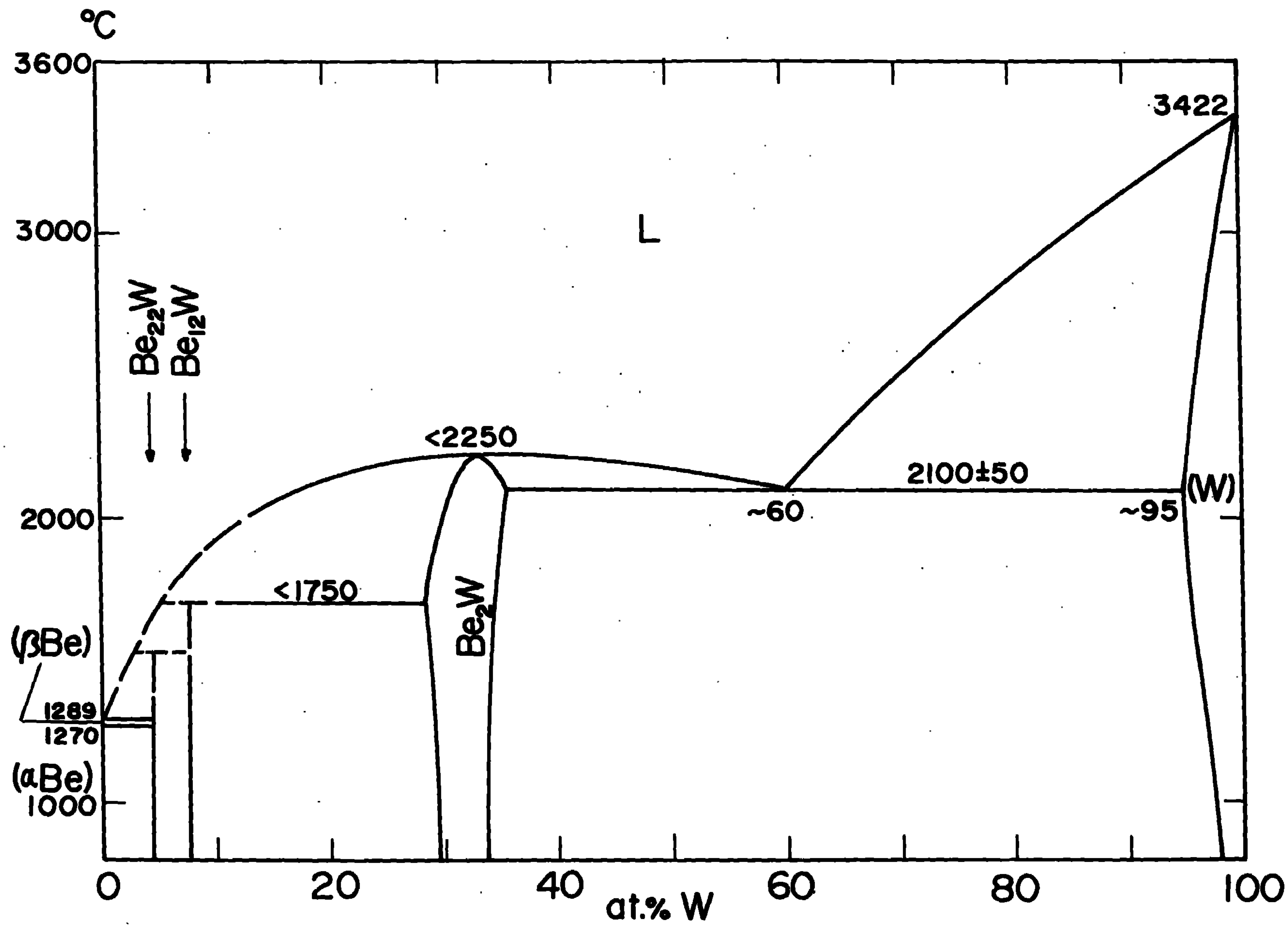

Fig. 1. Be-W assessed phase diagram.